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Prevalence of Hypertension among Active Duty Navy Personnel

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Summary

Problem

Hypertension is the most prevalent cardiovascular disease, afflicting approximately 30% of all American civilians. It is a major cause of stroke, coronary heart disease, and renal disease, which account for a large proportion of adult deaths in the United States. The purpose of this study was to determine the prevalence of high blood pressure in the U.S. Navy and to identify potential demographic correlates.

Method

Systolic and diastolic blood pressure readings were collected for 10,866 active duty men and women in conjunction with the Navy's current blood pressure screening program. During a 3-month period in 1989, dental clinics in four geographic regions logged blood pressures for all individuals presenting for routine examinations. Demographic information was also obtained for these participants.

Results

Mean systolic blood pressure was 118.3 mmHg, and mean diastolic blood pressure was 71.6 mmHg. Blood pressure was elevated in 8.9% of the total sample, which is lower than the age-adjusted rate for the nation at large (about 14%). The rate for enlisted personnel (9.3%) was significantly higher than for officers (6.1%). Hypertension was more prevalent among older individuals, men, and blacks; no differences were found for educational level or ship versus shore communities. While the rate of hypertension in the Navy was lower than the national rate, the demographic correlates were very similar in the two samples.

Conclusions

The relatively low prevalence of uncontrolled high blood pressure in the Navy may be related to screening policies at accession and/or the Navy's ongoing health and fitness programs, including exercise, weight control, and nutrition. To

illustrate, enlisted personnel, who had a 50% higher rate of hypertension than did officers, are more likely to be overweight, smoke more, and consume more alcohol, caffeine, and saturated fats. With nearly one in every ten sailors exhibiting elevated blood pressure, it is recommended that the Navy continue its efforts to modify high risk lifestyle behaviors and to develop a comprehensive, integrated approach to the screening, detection, treatment, and follow-up of hypertensives.

Prevalence of Hypertension among Active Duty Navy Personnel

D. Stephen Nice and Linda Kelly Trent

Hypertension is widely recognized as an important public health problem in contemporary life. Of the four major cardiovascular diseases--stroke, rheumatic heart disease, coronary heart disease, and hypertension--hypertension is the most prevalent, afflicting approximately 30% of American adult civilians (Drizd, Dannenberg, & Engel, 1986). Although mortality from high blood pressure appears to be relatively low, the disease is a major cause of cardiovascular disease, stroke, and renal disease, which account for a large proportion of adult deaths in the United States (American Heart Association, 1988; Kannel, 1977; Mathisen, Loken, Brox, & Stenback, 1969; Paul, 1974; Tyroler, 1980). The specific cause of essential hypertension is unclear, but multiple biobehavioral risk factors have been implicated in its etiology, including age, race, obesity, diet, and stress (American Heart Association, 1988; Shapiro & Goldstein, 1982).

Hypertension in the United States is somewhat more prevalent among men than among women (33% and 27%, respectively) and increases with age (Drizd, Dannenberg, & Engel, 1986). Cross-sectional data from both the Framington Heart Study (Kannel & Gordon, 1973) and the second National Health and Nutrition Examination Survey (NHANES II) (Drizd, Dannenberg, & Engel, 1986) indicate a sex-by-age interaction, such that mean blood pressures and concomitant prevalence of hypertension are seen to be lower in women than in men until middle age, after which point a crossover occurs, and they become higher in women than in men. However, when cohort data from the Framingham Heart Study were examined longitudinally, this crossover was not observed. Rather, as individuals actually aged, mean blood pressures in women remained lower than blood pressures in men at all ages (Kannel & Gordon, 1973). This difference between cohort and cross-sectional data may be due, in part, to the higher mortality of men with high blood pressure, which affects the cross-sectional curves but not the longitudinal ones (Detre, 1984).

Prevalence of high blood pressure is greater among black adults than white adults (38% and 29%, respectively), a difference largely attributable to differential rates among women (38% in black women, 25% in white women, versus 38% in black men, 33% in white men) (Drizd, Dannenberg, & Engel, 1986). Nevertheless, within the U.S. Navy, black men are hospitalized for hypertension almost three times more often than white men (Palinkas & Garland, 1983), and the black hypertensive (male or female) is more likely than his or her white counterpart to suffer associated morbidity and mortality (Wright, 1988). Race has also been found to be a significant predictor of children's hemodynamic responses (heart rate and blood pressure) to stressful situations (Murphy, Alpert, Willey, & Somes, 1988).

Race, gender, and age are unalterable risk factors, but other factors that contribute to high blood pressure can be modified or avoided. Dietary sodium (Dahl, 1972), alcohol (DeFrank, Jenkins, & Rose, 1987), and caffeine (Goldstein & Shapiro, 1987; Greenstadt, Yang, & Shapiro, 1988) have all been positively associated with increased blood pressure. Furthermore, the association between obesity and hypertension has been well established (Chiang, Perlman, & Epstein, 1969; Kannel, Brand, Skinner, Dawber, & McNamara, 1967; Sims & Berchtold, 1982). This association between body weight and blood pressure tends to be slightly stronger in women (Shapiro & Goldstein, 1982), and the effects are reversible with weight loss (Sims & Berchtold, 1982; Stamler, Stamler, Gosch, Civinelli, Fishman, McKeever, McDonald, & Dyer, 1989)).

Certain stressful situations which are a product of culture or urbanization have also been associated with high blood pressure. Harburg and his colleagues, for example, found a positive relationship between high blood pressure and living in high-stress neighborhoods, which were defined by high density, low socioeconomic status, high residential morbidity, and frequent marital breakup (Harburg, Erfurt, Hauenstein, Chape, Schull, & Schork, 1973). Although urban crowding has been implicated as a risk factor for hypertension (D'Atri & Ostfeld, 1975; Detre, 1984), these effects are inconclusive and may be mediated by other factors (Ostfeld, Kasl, D'Atri, & Fitzgerald, 1987). Hypertension may also be affected by job stress (Mustacchi, 1977; Shapiro & Goldstein, 1982) or constant

exposure to industrial noise (Andren, Hansson, Bjorkman, & Jonsson, 1980; Parvizpoor, 1976).

Given the range of behavioral factors associated with hypertension, many working-age individuals are at risk for developing hypertension but have not yet developed the associated complications (Glasgow & Terborg, 1988). This factor, in conjunction with the fact that hypertension is one of the most modifiable risk factors for heart disease and stroke (Alderman, 1984), strongly supports the continued development of worksite-based hypertension screening programs. Within the U.S. Navy, a screening procedure to assist in identifying unsuspected cases of high blood pressure is conducted in all dental facilities. During the initial and all annual dental examinations, the blood pressure of each dental patient is measured. Patients with elevated blood pressure are medically referred in accordance with the current guidelines from the report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (1984).

Although the prevalence of hypertension in the U.S. Navy is not known, Cohen and Curley (1986) reviewed the dental records of a pseudo-random sample of 532 Navy personnel and 744 Navy recruits and estimated the prevalence to be 9.4% and 6.2%, respectively. These investigators also reported significantly higher rates of hypertension among men and older personnel. The purpose of the present study was to examine the prevalence of hypertension in active duty Navy personnel and to identify potential demographic correlates.

Method

Procedure

The Navy's blood pressure screening program is carried out in dental clinics, where all dental patients over 5 years of age are tested at their annual routine examinations. In accordance with NAVMEDCOMNOTE 6600 of 2 July 1987, three blood pressure measurements are made during a single visit, and the average of these three constitutes the individual's blood pressure reading. Acceptable blood pressure level is defined as a diastolic pressure (DIAS) of less than 90 mmHg and a systolic pressure (SYS) of less than 140 mmHg. If blood

pressure is elevated, patients are referred for medical follow-up according to the following guidelines:

Routine: DIAS = 90-104 mmHg or SYS = 140-199 mmHg

Prompt: DIAS = 105-114 mmHg or SYS \geq 200 mmHg

Immediate: DIAS \geq 115 mmHG

For the present study, the Assistant Chief for Dentistry of the Bureau of Medicine and Surgery tasked naval dental commands in Jacksonville, Norfolk, Pearl Harbor, San Diego, and San Francisco to participate in a three-month study to document elevated blood pressure among active duty personnel. These commands were directed to record Social Security number (SSN), last recorded blood pressure (systolic and diastolic), current blood pressure (systolic and diastolic) and patient referral information on special data collection logs provided by the Naval Health Research Center (see Appendix). The commands were further instructed to restrict log entries to active duty personnel receiving routine annual dental examinations and to make all referrals within a two-week period. Points of contact at each command were then personally briefed on the purpose of the study, the information required, and the importance of limiting data collection to active duty Navy personnel.

Data were collected from January 1 through March 31, 1989. All of the participating clinics used a standard mercury sphygmomanometer and cuff to measure blood pressure. At the end of the data collection period, a total of 19,098 readings had been recorded. However, a number of duplicate SSNs indicated that readings for family dependents, or members who were not seen for routine annual examinations, may have been included in the logs. Therefore, all records having an SSN that appeared more than once in the data set were dropped. This reduced the number of blood pressure entries to 17,639.

Sample

To further ensure that the sample was exclusively active duty Navy, rather than dependents, retired personnel, or Marine Corps members, two more steps were taken. First, the blood pressure records were matched by SSN with demographic data from the Navy master personnel tapes, and nonmatches were

dropped from the subject pool. Second, each primary clinic was asked whether or not they had logged in blood pressures for other than active duty members, and if so, how many. Only one clinic responded in the affirmative, and their estimate of dependents seen, 3%, was less than the number of original records that had been eliminated for having duplicate SSNs. Therefore, the sample, which was reduced to 13,848, was presumed to represent only active duty Navy personnel.

After all data had been received and preliminary analyses performed, it was noted that the percent of individuals with elevated blood pressure was extremely low (1.4%) at one of the dental commands. This unusually low percentage was clearly an outlier, both in terms of the other four commands and in terms of national rates. As the data from this command were examined more closely, it was observed that the distributions of both systolic and diastolic blood pressure scores peaked just before the cutoff thresholds that marked clinically elevated blood pressure, i.e., at SYS=138 mmHg and DIAS=88 mmHg. This pattern was not seen in the other four commands and strongly suggested that a systematic bias existed in this command. The data from this command were therefore dropped from the study, resulting in a final sample of 10,866.

Demographic information which was extracted from the master files included age, sex, race, rank/paygrade, education, and ship versus shore status. The sample was 93% male (N=10,117) and 7% female (N=749). Mean age was 28.4 years, with a range of 17-65 years. Eighty-six percent were enlisted personnel, 14% were officers; all paygrades from E-1 through O-8 (with the exception of CWO1) were represented. The racial composition of the sample was 78% white, 13% black, and 9% other. There were slightly more shore-based individuals (54%) than shipboard (46%). All but 6% of the sample had completed high school or an equivalent certificate, and 25% had had more than 12 years of education. Overall, the demographic composition of the sample was very similar to the Navy at the time of the study (Table 1).

Comparisons with National Norms

Data from the second National Health and Nutrition Examination Survey (NHANES II, 1976-1980) (Drizd, Dannenberg, & Engel, 1986) were used in

Table 1.
Demographic Statistics for Navy Sample and Total Navy

<u>Variable</u>	<u>Navy Sample</u>	<u>Total Navy</u>
N of CASES	10,866	608,102
AGE (mean yrs)	27	28
SEX (%)		
Men	93	91
Women	7	9
RACE (%)		
White	78	79
Black	13	15
Other	9	6
STATUS (%)		
Officer	14	12
Enlisted	86	88
EDUCATION (%)		
<12 years	6	6
12 years	69	73
>12 years	25	21
COMMUNITY (%)		
Ship	46	48
Shore	54	52

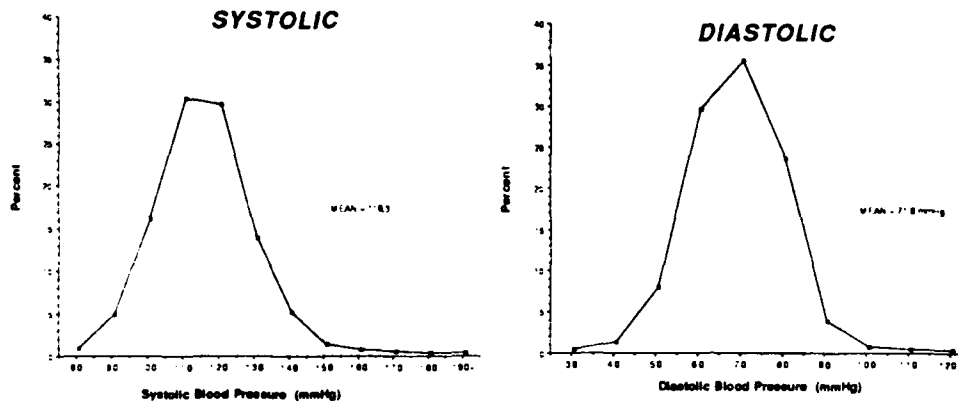
analyses comparing Navy hypertension rates with national norms. The NHANES II data, which are based on U.S. civilians ages 18-74, were age-adjusted to ages 18-44 only, in order to be comparable with the younger Navy sample. The percentage of controlled hypertensives (those whose blood pressure was normal but who were classified as hypertensive because they were taking anti-hypertensive medication) was then subtracted from normative prevalence rates, resulting in estimated prevalence rates for uncontrolled hypertension in the nation for people 18-44 years of age. The Navy sample was likewise restricted to ages 18-44 for comparisons with national data; 97.8% of the sample fell within this age range. Navy prevalence rates reflected only uncontrolled hypertension.

Results

Across all active duty personnel in the sample, the mean systolic blood pressure was 118.3 mmHg (S.D.=13.0 mmHg), and the mean diastolic blood pressure was 71.6 mmHg (S.D.=10.2 mmHg). The distributions of systolic and diastolic blood pressures are presented in Figure 1. Among the four dental

Figure 1.

**Systolic and Diastolic Blood Pressure Distributions
among Active Duty Navy Personnel**



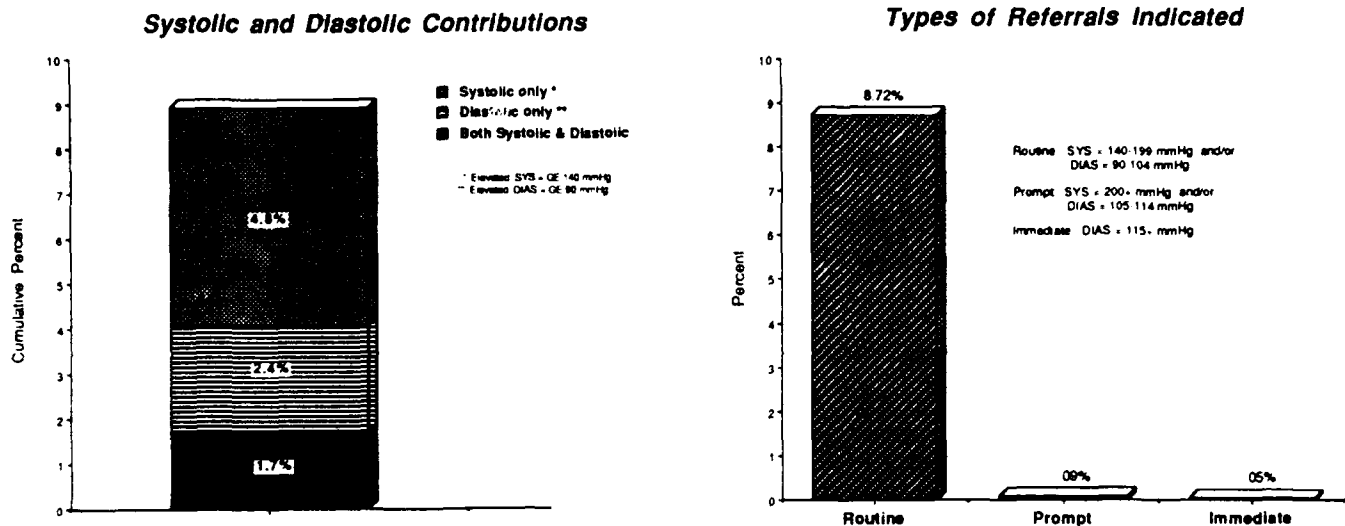
commands in the study, the mean systolic blood pressure ranged from 115.6 mmHg to 119.7 mmHg, and the mean diastolic blood pressure ranged from 70.7 mmHg to 75.8 mmHg.

A total of 8.9% ($\pm 6\%$) of the sample had elevated blood pressure at the time of their routine dental examination. As shown in Figure 2, over one-half of these cases of high blood pressure (54%) demonstrated an elevation in systolic blood pressure only. Approximately one-fourth of the cases (27%) demonstrated an elevation in diastolic blood pressure only, and about one-fifth of the cases (19%) were elevated on both systolic and diastolic blood pressure. Nearly all of the cases of high blood pressure (98%) indicated the least immediate ("routine") category of medical referral (i.e., DIAS=90-104 mmHg and/or SYS=140-199 mmHg).

In order to assess the factors associated with elevated blood pressure in this sample of Navy personnel, a series of chi-square analyses were conducted between blood pressure (elevated, not elevated) and age (17-24, 25-34, 35-44, 45-54), sex, race (black, white), education (< high school diploma, high school diploma, > high

Figure 2.

Proportional Characteristics of Overall Hypertension Rate (8.9%) in Active Duty Navy Personnel



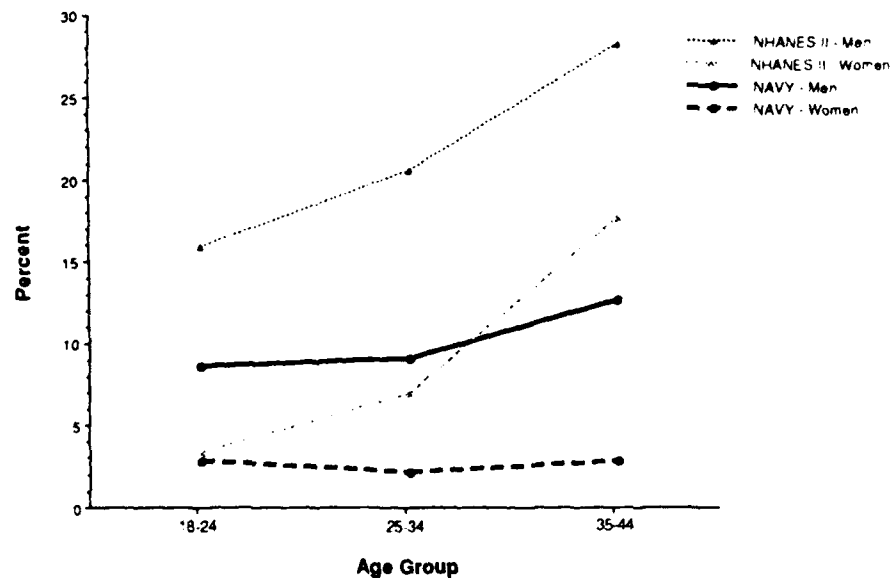
school diploma), military status (officer, enlisted), and community (ship, shore). As shown in Table 2, elevated blood pressure was strongly related to both age and sex, with older individuals and men being more likely than their counterparts to be hypertensive. In addition, enlisted personnel were significantly more likely to have elevated blood pressure than were officers, and blacks were more likely to have high blood pressure than were whites. No differences were found for education or community.

Navy blood pressure data were compared with national data from NHANES II (Drizd, Dannenberg, & Engel, 1986) for ages 18-44 only. Figure 3 shows the percentage of individuals with high blood pressure within each age group for both men and women, Navy versus NHANES II samples. Hypertension rates increased with age in all groups except Navy women, whose rates remained very low and essentially unchanged across the age span. The overall prevalence rate for Navy women (2.1%) was significantly lower than the rate for women nationwide (8.3%) [$\chi^2(1)=34.57$, $p<.01$]. Similarly, the overall rate for Navy men (9.2%) was

Table 2.
Demographic Differences in Percent of Hypertensive
Individuals among Active Duty Navy Personnel

Variable	N	Percent with elevated blood pressure	χ^2	P<
AGE (yrs)			41.5	.001
17-24	3,848	7.8		
25-34	4,828	8.1		
35-44	1,944	11.9		
45-54	230	15.2		
55+	11	9.1		
SEX			42.3	.001
Male	10,117	9.3		
Female	749	2.3		
RACE			4.1	.05
White	8,480	8.6		
Black	1,440	10.3		
STATUS			16.6	.001
Officer	1,517	6.1		
Enlisted	9,349	9.3		
EDUCATION (yrs)			3.5	(n.s.)
<12	685	8.2		
12	7,423	9.2		
>12	2,758	8.1		
COMMUNITY			0.1	(n.s.)
Ship	5,014	9.4		
Shore	4,332	9.2		

Figure 3.
Percent of Hypertensive Individuals by Age and Sex:
Navy vs. Nation* (NHANES II), Ages 18-44



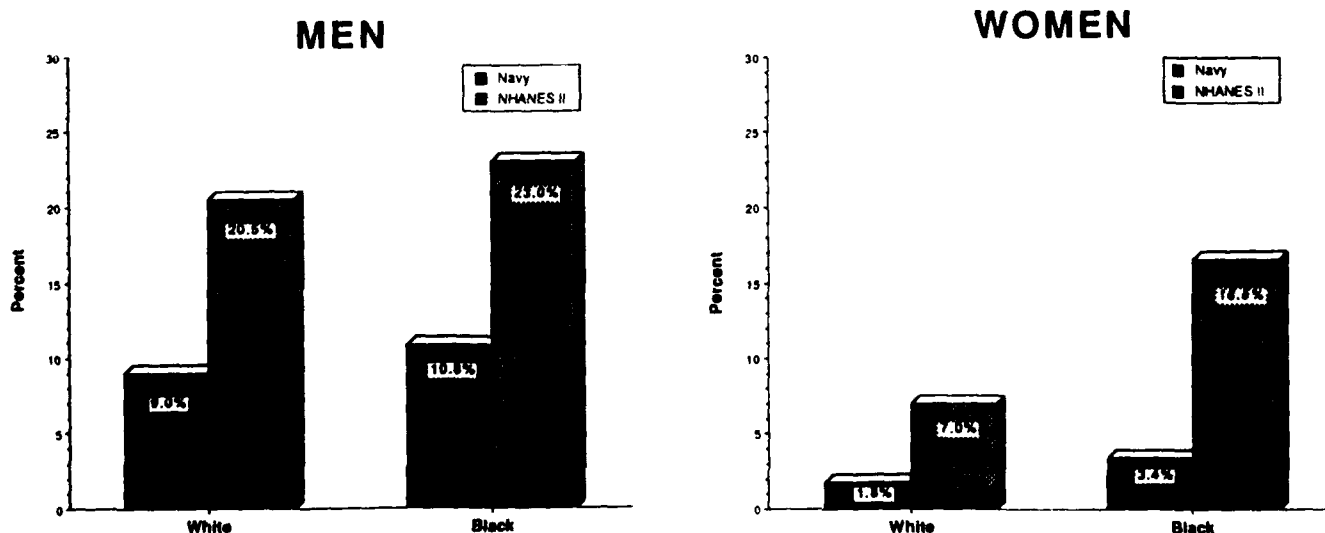
* Source: National Health and Nutrition Examination Survey II, 1976-1980

significantly lower than for men nationwide (20.6%) [$\chi^2(1)=274.16$, $p<.01$]. Rates for men exceeded rates for women in both samples.

Figure 4 presents hypertension rates by race and sex, ages 18-44 only, Navy versus NHANES II samples. It can be readily observed that Navy rates were lower than national rates in all groups; i.e., among both men and women, Navy whites had lower hypertension rates than whites nationwide, and Navy blacks had lower rates than blacks nationwide. Within the Navy sample itself, hypertension was somewhat more prevalent among black men than white men [$\chi^2(1)=4.23$, $p<.05$], but the race effect was not significant for women. The reverse was true for the national sample, where high blood pressure was significantly more prevalent among black women than white women ($\chi^2(1)=39.50$, $p<.01$) but not among black men versus white men. However, given the relatively small number of black women in the Navy sample ($N=147$), these comparisons should be interpreted with caution.

Figure 4.

Percent of Hypertensive Individuals by Race and Sex: Navy vs. Nation* (NHANES II), Ages 18-44



* Source: National Health and Nutrition Examination Survey II, 1976-1980

Discussion

The results of this investigation indicate that approximately 8.9% of active duty Navy personnel had elevated blood pressure during their annual blood pressure screen. This figure is quite close to the 9.4% estimate presented by Cohen and Curley (1986) and indicates that approximately 54,000 Navy active duty personnel have uncontrolled high blood pressure. Because the data in the present study were collected in dental treatment facilities, there may have been some false positives due to situational stress. However, given the fact that data were collected only from individuals reporting for routine annual check-ups, false positives were not considered a significant issue. Although the study was designed to capture confirmatory medical diagnostic data on individuals whose blood pressure was elevated at the dental clinic screen, inadequate compliance with referral and feedback procedures precluded this aspect of the study.

Overall, the rates of hypertension among active duty personnel in this study were considerably lower than the age-adjusted rates reported for the nation. It is important to remember, however, that the national data were collected between 1976 and 1980 and may not reflect current levels of hypertension in the U.S. population. Although the overall rate of uncontrolled hypertension in the Navy (8.9%) was lower than the adjusted national rate (about 14%, extrapolated from Drizd, Dannenberg, & Engel, 1986), the demographic correlates were very similar in the two samples. The finding that men, older people, and blacks in the Navy exhibited higher rates of hypertension is consistent with results from the national data. Interestingly, the present study also found that Navy enlisted personnel had a 50% higher rate of high blood pressure than did officers. This difference may be related to the fact that Navy enlisted personnel consume more caffeine, smoke more cigarettes, engage in less healthful eating behaviors, and are more likely to be overfat or obese than are officers (Conway, Trent, & Conway, 1989).

Although the great majority of Navy personnel with elevated blood pressure in this study were in the routine referral range, this does not reduce the importance of continued efforts to identify and treat individuals at risk. As

Ward (1984) points out, actuarial, epidemiologic, and clinical data confirm that the risk of subsequent illness and/or death increases with blood pressure. Even within the normal blood pressure ranges, the relationship persists: A person with a blood pressure of 130/80 mmHg is at greater risk of premature death or illness from heart failure, heart attack, stroke, or kidney failure than an individual with a blood pressure of 110/70 mmHg. These risks begin to accelerate at a level of about 140/90 mmHg, the cutpoint in the Navy screening program. It is important to point out that programs which provide only screening and detection rather than integrated referral, treatment, and follow-up components fare poorly (Glasgow & Terborg, 1988; Haynes, Sackett, & Taylor, 1978). While this does not imply the necessity for on-site treatment if adequate liaison and follow-up are provided (Alderman, 1984), it does underscore the importance of a comprehensive, integrated approach to the screening, detection, treatment, and follow-up of hypertension.

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Appendix: Data collection log

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FIELD	GROUP	SUB-GROUP	Hypertension, High Blood Pressure, Health Promotion, Cardiovascular Disease (JG)	
19. ABSTRACT (Continue on reverse if necessary and identify by block number) The primary purpose of this study was to estimate the prevalence of uncontrolled hypertension in the Navy. Systolic and diastolic blood pressure readings were collected for 10,866 active duty men and women in conjunction with the Navy's current blood pressure screening program. Mean systolic blood pressure was 118.3 mmHg, mean diastolic blood pressure was 71.6 mmHg. Blood pressure was elevated in 8.9% of the total sample, which is lower than the adjusted rate for the nation at large (about 14%). Hypertension was more prevalent among enlisted personnel, older individuals, men, and blacks. The relatively low prevalence of hypertension in the Navy may be related to screening policies at accession and/or the Navy's ongoing health and fitness programs, including exercise, weight control, and nutrition. However, with nearly 1 in 10 sailors exhibiting high blood pressure, it is recommended that the Navy continue its efforts toward a comprehensive program for detection and treatment of hypertension.				
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
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